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ANTENNAL SENSILLA OF SOME CRAMBINAE[1]

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ABSTRACT

When the antennal sensilla of several common species of Crambinae were studied with the scanning electron microscope, trichoid sensilla were dominant; the primary function of Crambinae antennae may therefore be detection of semiochemicals. Sensilla chaetica (mechanoreceptors) were well represented and would be useful to the moths for orienting within the grass canopy. Sensilla coeloconica and styloconica were present, but sensilla auricillicum were absent. The sensilla of Crambinae are simple and functional relative to those of many Lepidoptera and appear to be designed for orientation within grassland habitat.

Many Lepidoptera explore a large habitat (e. g., a forest) and make relatively long flights in response to various stimuli that are perceived by antennal sensilla of various sizes, arrangements, densities, and sculpturing (Callahan, 1975). Adult Crambinae (the grass-feeding larvae are commonly referred to as sod webworms), in contrast, make short, erratic flights (3-5 meters) within or slightly above the canopy of grass and also explore the interior of the canopy by walking. The male perceives and orients to the sex pheromone of females during flight (Banerjee and Decker, 1966; Kamm, 1974). Both sexes, particularly females heavy with eggs, often fall to the ground in response to mechanical stimuli and feign death rather than attempt escape by flight. Since information about the antennal sensilla of the Crambinae would help to understand the mechanism by which adults perceive their environment, a study was made to determine the types of sensilla on the antennae of several common species of Crambinae and to relate the types with known functions to the behavior of the moths.

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MATERIALS AND METHODS

Study moths were reared in the laboratory from insects collected near Corvallis, Ore. (Kamm 1970). The antennae of five species of both sexes were excised from newly emerged adults, cut into pieces of several segments, and mounted on a specimen stub with fast drying silverpaint. The mounted antennal segments were then coated with a thin layer of gold-palladium alloy and observed with the scanning electron microscope. In this way, the entire circumference of the flagellum of females could be scanned by using a single segment, but two segments had to be used in observing both sides of the male sensilla since they surround most of the flagellum. Segments from five antennae of each sex were examined for each species. Measurements of sensilla were made at random locations on the antennae but sensilla that arose from or were adjacent to the scale area of the flagellum were avoided because they were often of atypical shape and size. The terminology of Schneider (1964) was used to classify the sensilla described herein. The species studied were: *Crambus tutillus* McDunnough, *Chrysoteuchia topiaria* (Zeller), *Pediasia trisecta* (Walker), *Crambus leachellus cypridalis* Hulst, and *Tahama bonifatella* (Hulst) all of which are commonly found in the grasslands in the Willamette Valley of Oregon.

OBSERVATIONS

The antennae of all five species were typical setiform and had a scape, pedicel, and variable number (45-72) of flagellar segments. Also, the spine-like Bohm bristles were present in groups on the scape and pedicel of all species. In general, the number of sensilla on each flagellum decreased toward the distal end of the antenna. The shape of the flagellum was variable and different among species and sexes. Males always had more sensilla per flagellum, and they covered an estimated 75 percent or more of the surface area of the flagellum; the remaining area on all species except *P. trisecta* was covered with scales, but *P. trisecta* had some scales among the field of the sensilla. The sensilla on females covered 50 percent or less of the surface area of a typical segment. This difference between sexes was just dicernible on the high power (45 x) of a binocular microscope with good resolution. The net-like sculpturing on the flagellum was similar among species but lacked the rough textured terrain common on the antennae of some Lepidoptera (Jefferson et al., 1970). The range in size (μ) of sensilla is given in Table 1.

Table 1. Range in size (μ) of 10 randomly selected sensilla on the antennae of five species of Crambinae.[1]

Type of sensilla	C. topiaria	C. tutillus	C. l. cypridalis	T. bonifatella	P. trisecta
Trichoid I	27 - 32	25 - 34	27 - 35	24 - 30	29 - 32
Trichoid II	12 - 21	15 - 25	11 - 18	11 - 20	11 - 20
Chaetica	28 - 47	25 - 32	27 - 48	14 - 42	21 - 35
Coeloconica (width of pit)	7 - 8.5	5 - 7	6 - 7	8 - 10	9 - 11
Styloconica[2] (elevation from base flagellum)	10 - 12	7 - 9	7 - 10	11 - 14	7 - 12

[1] Measurements made with millimeter rule from micrographs.

[2] Reliable measurements of the sensory cone not possible.

Two types of trichoid sensilla were distinguished: type I (T-I) was curved and sharply hooked at the tip; type II (T-II) was shorter than type I, was slightly curved though it lacked the pronounced hook at the tip, and was almost always adjacent to type I sensilla (Fig. 1-A). Type I was the most abundant sensilla on the antennae of both sexes. Neither type had any discernible longitudinal or annular striations on the surface (Fig. 1-B).

Sensilla chaetica (Ch) were present on most flagellar segments on all species (Fig. 1-C). High magnification revealed some with longitudinal or annual striations (Fig. 1-D) but most had a smooth surface. No constant pattern or distribution on the flagellar segments was apparent, but the terminal segments of both sexes often had several sensilla chaetica that extended beyond the apices which suggested a tactile function.

Sensilla coeloconica (Co) occurred in clusters of 2-3 sensilla on most flagella (Fig. 1-E) and were nearly always located away from the scales of the flagellum. However, the peg is corrugated longitudinally in *C. topiaria* and arises from a shallow pit surrounded by slanting spines (Fig. 1-F).

Sensilla styloconia (St) were present on the distal margin of most flagellar segments of all species but occasionally were absent from some segments (Fig. 1-C). The elevation of the cuticle that ends in these sensory cones varied among species (Table 1). In general, only one sensilla styloconica was present on a flagellar segment but there were exceptions. Females of *T. bonifatella* often had a flagellar segment with a single sensilla followed by a segment with two sensilla. The tip of the terminal segment had what appeared to be a modification of sensilla styloconica that appeared in clusters of 2-4 sensilla (Fig. 1-D) and were probably specialized for close range perception of stimuli.

DISCUSSION

The species investigated had the types of sensilla found commonly on the antennae of many Lepidoptera. However, the trichoid sensillum was dominant which suggests that the primary function of the antennae is to detect semiochemicals. Since the trichoid sensilla of male Lepidoptera are known to respond to the sex attractant of females (Schneider, 1962), they probably have a similar function in the Crambinae. The sensilla coeloconica are olfactory in some insects but in Lepidoptera they also respond to warm humid air (Schneider and Steinbrecht,

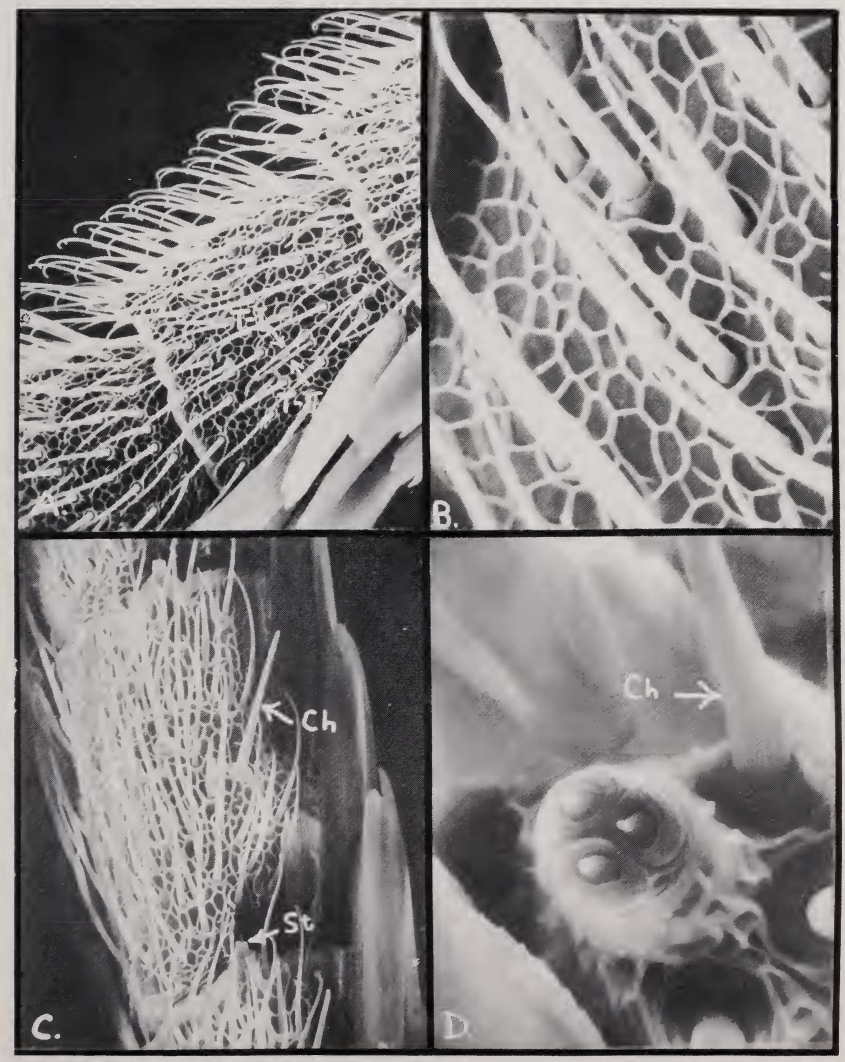
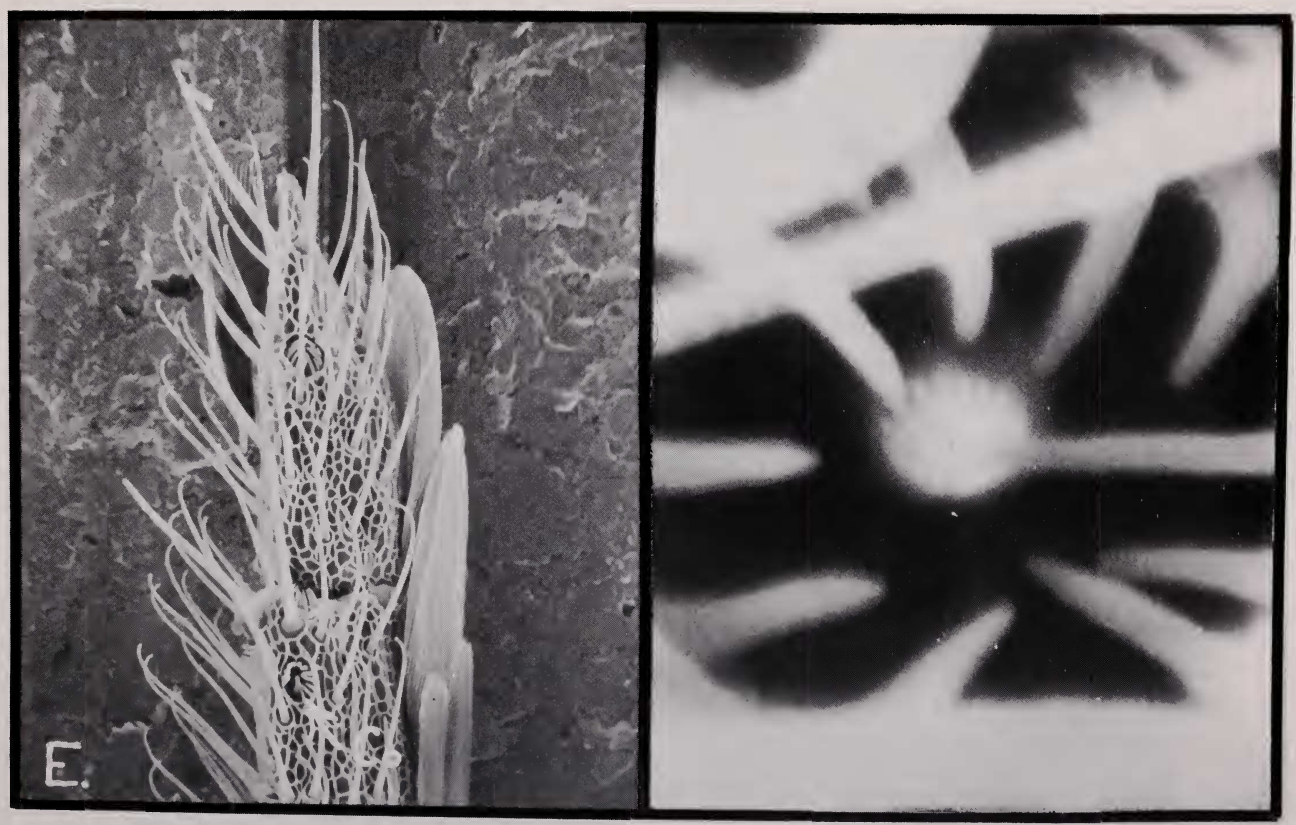


Fig. 1.—A. *C. topiaria* ♂, 700x Sensilla trichodea (T-I); Sensilla trichodea (T-II). B. *C. topiaria* ♂, 3000x (note smooth surface texturing of sensilla). C. *C. topiaria* ♀, 1000x Sensilla chaetica (Ch), Sensilla styloconica (St). D. *T. bonifatella* ♀, 5000x; cluster of sensory cones on distal end of terminal segment.



E. *C. topiaria* ♂, 700x Sensilla coeloconica (Co). F. *C. topiaria* ♀, 15,000x; grooved peg of sensil coeloconica.

1968), which would be useful to the insect in identifying oviposition sites. The sensilla chaetica are known mechanoreceptors (Schneider, 1964) and are well represented in the Crambinae. Since these adults explore the leaves and culms of grasses by walking, these sensilla are probably essential for orientation within the grass canopy. Females, which have more sensilla chaetica, probably rely more on these receptors than males since flight is difficult and impractical for females heavily laden with eggs.

Relative to many Lepidoptera, the Crambinae have fewer sensilla and some types are conspicuously absent. For example, the auricillicum sensilla (shoe horn sensilla) probably provide directional perception of stimuli as the insect orients to the source but these sensilla were absent in the study species. The Crambinae also lacked the various types of surface texturing on olfactory sensilla that may permit the insect to distinguish several types of odors with a single sensilla (Callahan, 1975). Thus, the sensilla of the study species were simpler and had a more functional design that those of many Lepidoptera. However, they are well adapted to orientation within the limited habitat of the grass canopy that adult Crambinae explore.

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